experienced by both diversity signals simultaneously. As a result, current diversity techniques do not seem to be adequate for mobile radio and other applications where radio waves propagate in close proximity to the ground and multipath signal reception is frequently encountered.

Other diversity communication techniques have been developed. See United States Patents 4,384,358, 5,291,579, 5,379,324, 5,402,451, 5,465,271, 5,487,091, 5,541,963, 5,566,364, 5,559,838 and 5,515,380. The patent 5,515,380 claims a method and a device which achieves significant performance improvements using diversity signal reception. The transmitted data are organized into blocks of bits. A block can be tens of bits long if parity bits are used or hundreds of bits long in case of FEC. Each block is augmented by adding error identification or correction bits, which upon signal reception and demodulation determine whether a given block contains errors. If a given block contains errors, the corresponding block received on the other diversity signal is hoped to be error free, in case of parity bit checking, or degraded to a lesser extent, in case of FEC block coding. The error-free, or better block, is selected to the output. However, when both diversity signals are affected by intermittent error bursts, the selection technique becomes ineffective. This is because parity bits ignore even number of errors and do not differentiate between single and a larger number of errors. FEC techniques use large data blocks which are likely to be similarly impaired by intermittent radio error bursts.

Fig. 1 illustrates a block diagram of a prior art space diversity communication system 10. The system includes a transmitter 12 which receives a baseband data input which modulates a carrier and transmits the modulated carrier from an antenna 14 through two separate transmission paths 16 and 18 to a pair of spaced apart antennae 20 and 22. These antennae are separated by a sufficient distance (e.g. a few wavelengths) to provide separate communication paths which are not subject to the same fading phenomena, such as Raleigh fading or other phenomena which degrade both transmissions 16 and 18 simultaneously. The received signal from antennas 20 and 22 is applied respectively to a pair of receivers 24 and 26. The output signals from the receivers 24 and 26 are applied to a combiner 28 which, as described above, functions to combine the output signals to produce a baseband output. The combiner 28 does not perform a comparison of respective streams of data units (e.g. bits) to choose and output individual data units as received from receivers 24 and 26 in circumstances where at least one difference in at least one data unit of a sequence of corresponding data units is identified and processing each data unit within the at least one difference of the sequence of corresponding data units to output data units having a higher probability of not being in error.

Fig. 2 illustrates a block diagram of a prior art frequency diversity system 30. A first transmitter 32 modulates a carrier of a first frequency with the baseband input and a second transmitter 34 modulates a carrier of a different frequency with the same baseband input. Antenna 36 broadcasts the respective modulated carriers 38 and 40 produced by transmitters 32 and 34 to a single antenna 42. The different frequency carriers are applied to receivers 44 and 46 which respectively process the data streams broadcast on carriers 38 and 40. Combiner 48 works in the same manner as combiner 28 of Fig. 2 and does not detect when at least one difference in at least one

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detected, data units of any diversity signal (this will usually be the last signal selected) are passed to the data selector output as valid data. If a single error or error burst is detected in the at least two diversity signals, i.e. data units of the corresponding I or Q components disagree (quadrature modulation assumed), a sum of weighted distortion parameters f(SD) of the corresponding diversity signal components is used to identify the diversity data unit sequence which is most likely correct (non-erroneous). In the event of an error or error burst, the diversity data unit(s) which are least likely to be erroneous are multiplexed to the output, so that from the at least two diversity data unit sequences, one essentially error-free output data unit sequence is reconstituted.

Experimental studies on digital radios using 9QPR modulation have shown that the radio error bursts are random events which usually affect one to about 15 consecutive data units. As the S/N decreases, the error events which affect multiple consecutive data units appear more frequently.

Because of the statistical independence of the diversity signal error events, errors can be identified with a high probability by comparing corresponding data units of at least two diversity signals. If the data units agree, both signals are most likely correctly demodulated. If they do not agree, one diversity signal is incorrectly demodulated and the baseband signal distortion parameters of the errored and one or more immediately adjacent data units can be used to identify the diversity signal which is most likely in error.

Because the error burst detection process relies on a data unit comparison, errors which occur in all of the diversity signal components simultaneously cannot be corrected. Furthermore, if all diversity signals are experiencing an error rate of at least 10^{-2}, the error signal identification procedure may be less efficient and result in additional errors appearing at the selector output. If two diversity signals are used, and one receiver looses synchronization due to a very poor S/N or hardware failures, only one receiver is synchronized. During such condition, the data selector will pass the other signal to the output. Therefore, any error burst on the synchronized signal appears at the selector output. Taking all possible error alternatives into account, the output bit error rate of the data selector, when two diversity signals are used, can be expressed as:

$$BER_D = \frac{1}{\tau_M}\left(\tau_1\left(BER_{I1} + BER_{Q1}\right) + \tau_2\left(BER_{I2} + BER_{Q2}\right) + \frac{1}{\sigma}\int_0^{\tau_M - \tau_1 - \tau_2}\left\{BER_{I1}(t)BER_{I2}(t)P[BER_{I1}/BER_{I2}] + BER_{Q1}(t)BER_{Q2}(t)P[BER_{Q1}/BER_{Q2}]\right\}dt\right) \tag{20}$$

EQUATION NOT LEGIBLE – TO BE REPLACED BY LARGER FONT

where τ_M is the bit error rate measurement period, τ_1 and τ_2 are fractions of τ during which only the first or second diversity signal is synchronized and σ is the overall selector efficiency. P[BER$_{I1}$ / BER$_{I2}$] and P[BER$_{Q1}$ / BER$_{Q2}$] are conditional probabilities.

It should be understood that the overall process, with the exception of the data selection process described below in conjunction with Figs. 5 and 6, may be practiced with a prior art diversity radio system components such as, but not limited to, the radio system components of Figs. 1 and 2, except that the combiners 28 and 48 respectively therein are replaced with the data selector and further, preferably, ~~employerror~~ employ error correction code to further improve the integrity of the transmitted data in accordance with the prior art of Fig. 3. The transmitter used with the present invention may be in

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where τ_M is the bit error rate measurement period, τ_1 and τ_2 are fractions of τ during which only the first or second diversity signal is synchronized and σ is the overall selector efficiency. $P[BER_{I1}/BER_{I2}]$ and $P[BER_{Q1}/BER_{Q2}]$ are conditional probabilities.

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